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Dynamic Wildfire Risk Mapping: Challenges and Solutions

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Dynamic Wildfire Risk Mapping

- Introduction
- Approaches to Modeling Fire
- Current Research
  - VESTA
  - Fire Information Engine
- Future Directions of Fire Modeling

Wildfire Stats

- ~ $1 Billion / Year
- > 50,000 Fires
- > 1,000,000 Acres
  (Human-Caused)

  2003 California Fires
  Cerro Grande
  Oakland Hills

Introduction

Domains:

- Human / Social
- Ecological
- Physical
- Environmental
- Climatological (Climate Change)

Approaches:

- History (Ecological)
- Risk / Hazard (Sociological)
- Spread (Mechanistic)
- Dynamics (Physics)

Introduction

At What Scale, Fire?

Fine scale

- Meters-Kilometers, Minutes-Hours, People

Continental scale

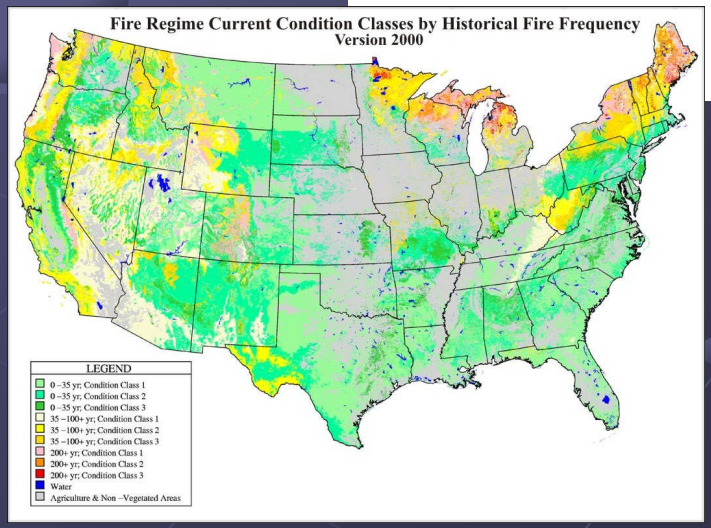
- States, regions, Seasons – Centuries, Civilizations

Behavior, Risk, Spread, and Dynamics

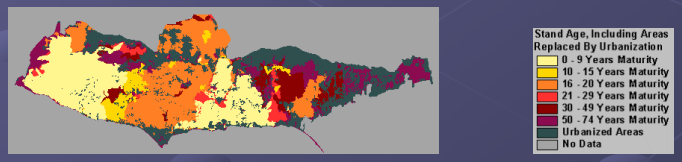
Current Approaches

Ecological:

- Fire Regime Analysis
- Succession Patterns
  - LANDIS-II
- Remote Sensing
  - Burn Histories



Landscape-scale Dynamics



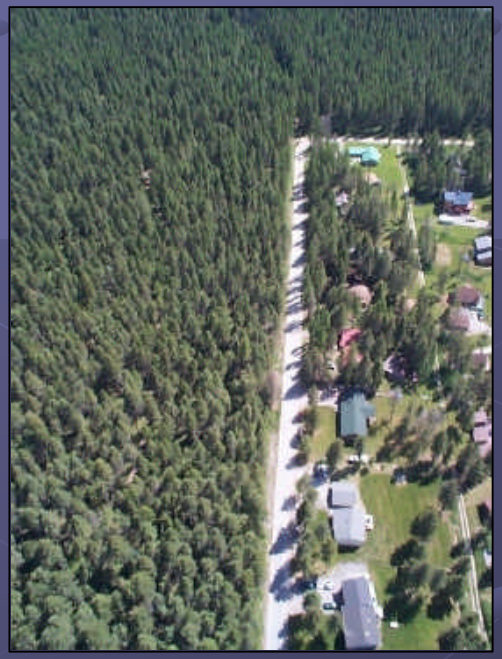
Santa Monica Mountains Stand Maturity

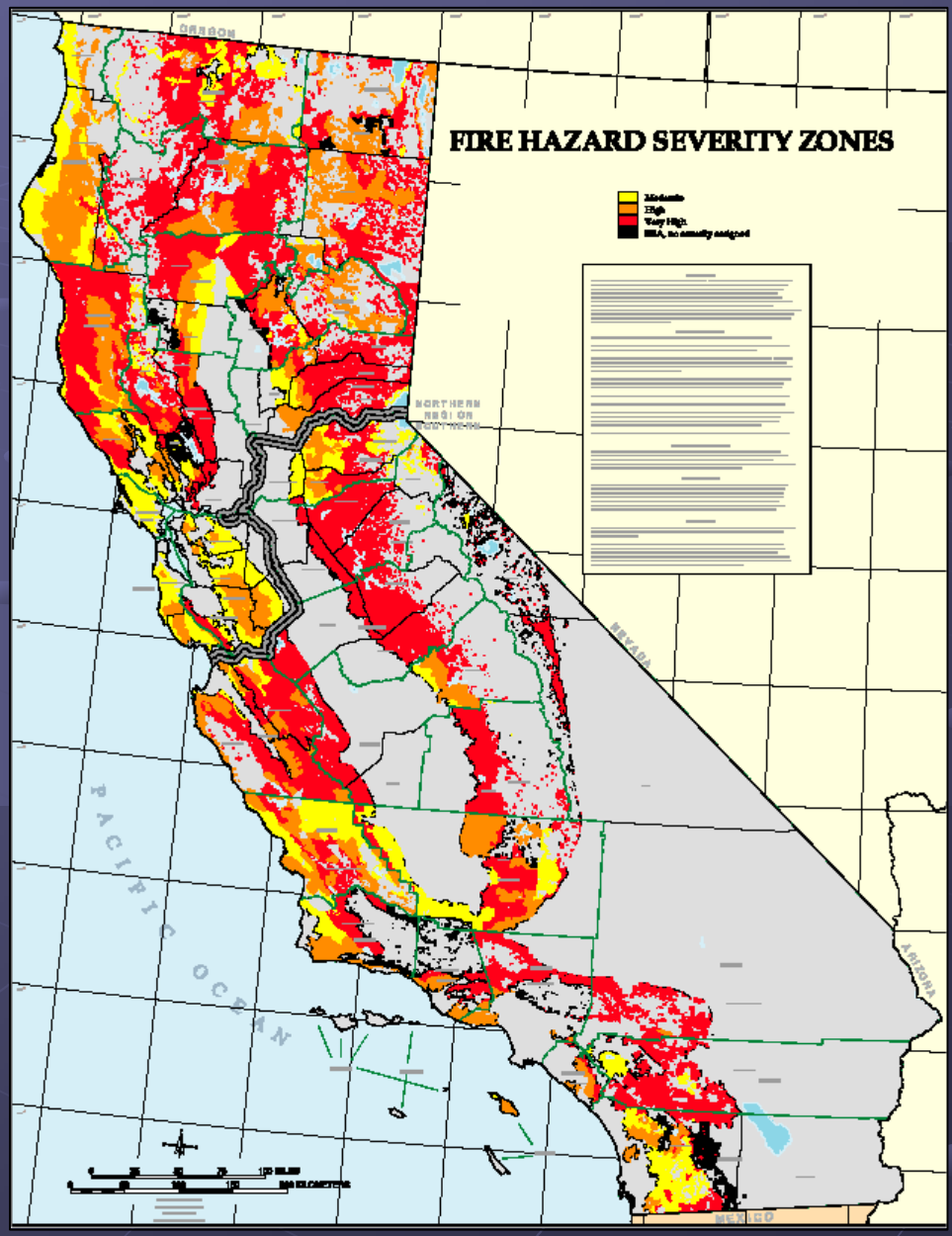
Current Approaches

Sociological:

Wildfire Risk

Wildfire Hazard

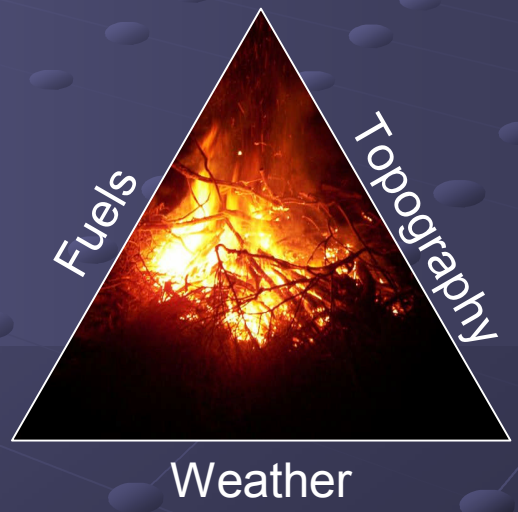




Current Approaches

Mechanistic, Deterministic Spread:

- Rothermel Equations (1972)
- Fire Behavior Triangle
- Other Parameters:
  - Fuel Moisture
  - Fuel Type
  - Ignition Intensity



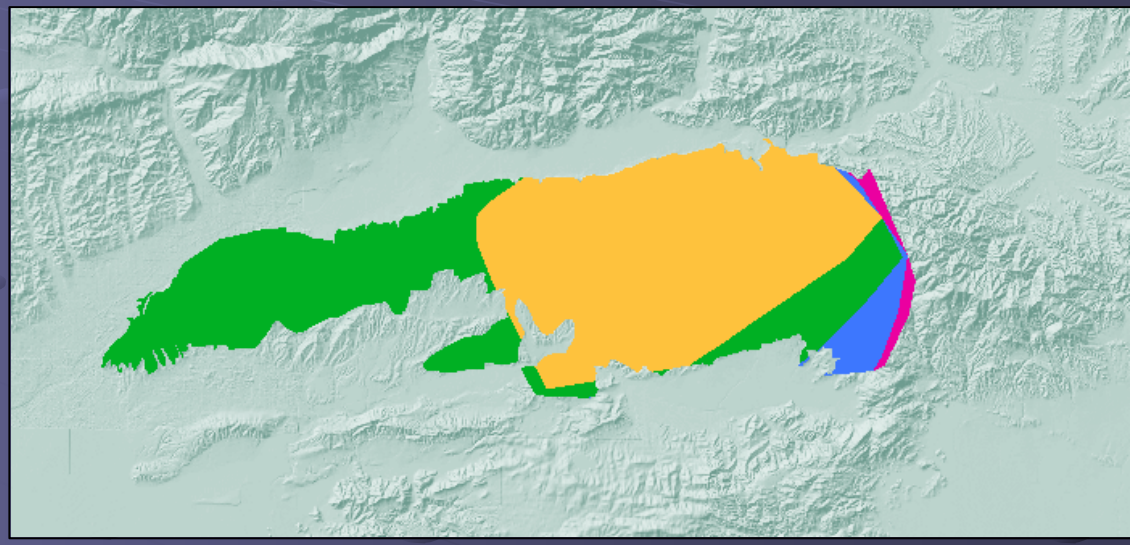
Current Approaches

Mechanistic, Deterministic Spread:

BehavePlus

FARSITE

HFire



2003 Simi Fire: 10 days,
$10 Million, > 100,000 Acres

Current Approaches

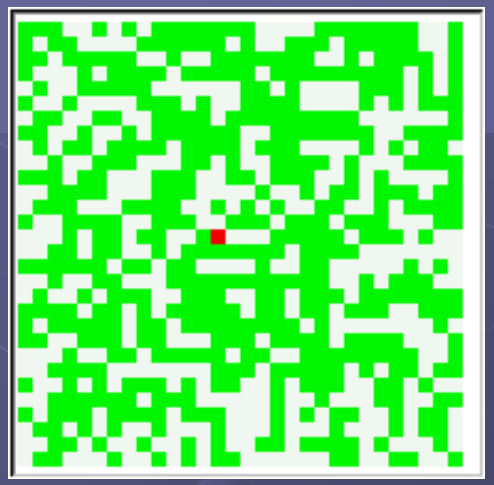
Physics – based (Dynamics):

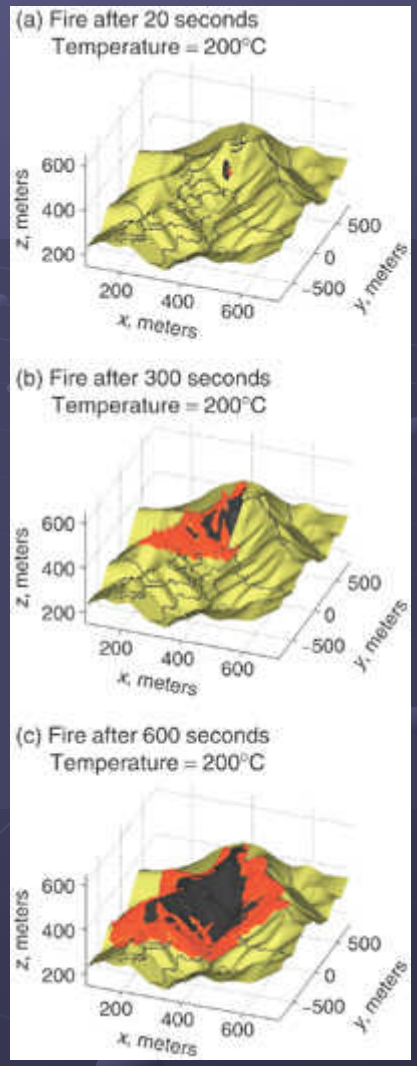
- IBM (ABM) or CA- based models

  Explore Power-law relationships

- FIRETEC Full Physics Coupled

  Atmospheric Model





~~Current Approaches~~

Extant Approaches are not ***dynamic***:

- Weather
- Human Behavior
- Policy
- Vegetation
- Fire Fighting

No one model incorporates all of these

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VESTA

- Decisions of Land Use & Fire Management
  - Made in isolation
  - Short-term vision

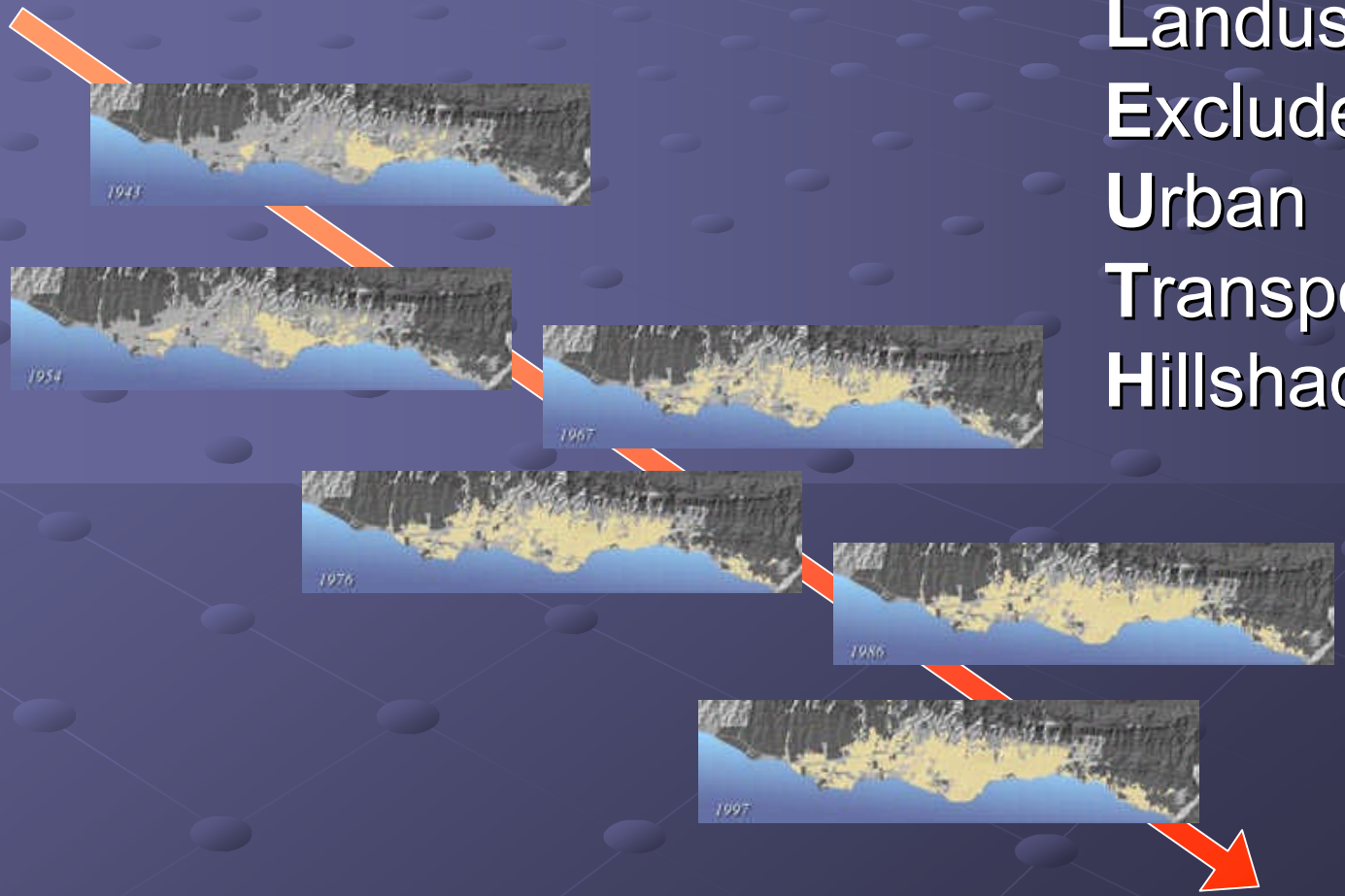
SLEUTH + Wildfire *Risk* Model = VESTA

- Why Risk?
  - Probability
  - Common Denominator
    - Allows cross-walking between models
    - Appropriate time scale

The SLEUTH Model of Urban Growth

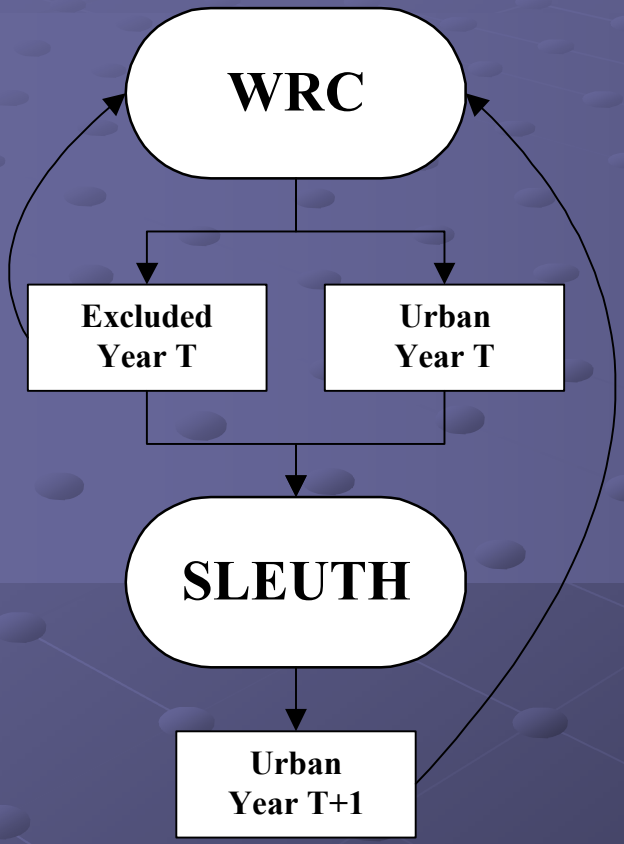
Developed By Clarke et al

SLEUTH: **S**lope
Landuse
Excluded
Urban
Transportation
Hillshade

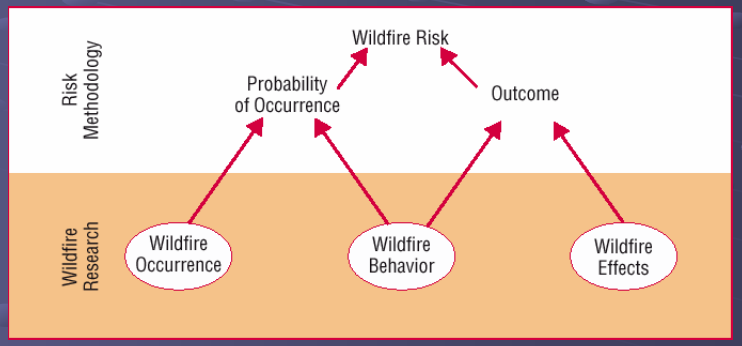


Wildfire Risk Component

Data Flow in Vesta



P(burning) = r = μ x ρ



Bachmann & Allgower, 2001

For a given year, if P(burning) > X, cells are “burnt”

Wildfire Risk Component Data

Factors of μ (occurrence)

- Topography
- Weather
- Distance to:
  - Fuels
  - Ignition
  - Roads
  - Wildland Urban Interface (WUI)

Factors of ρ (outcome)

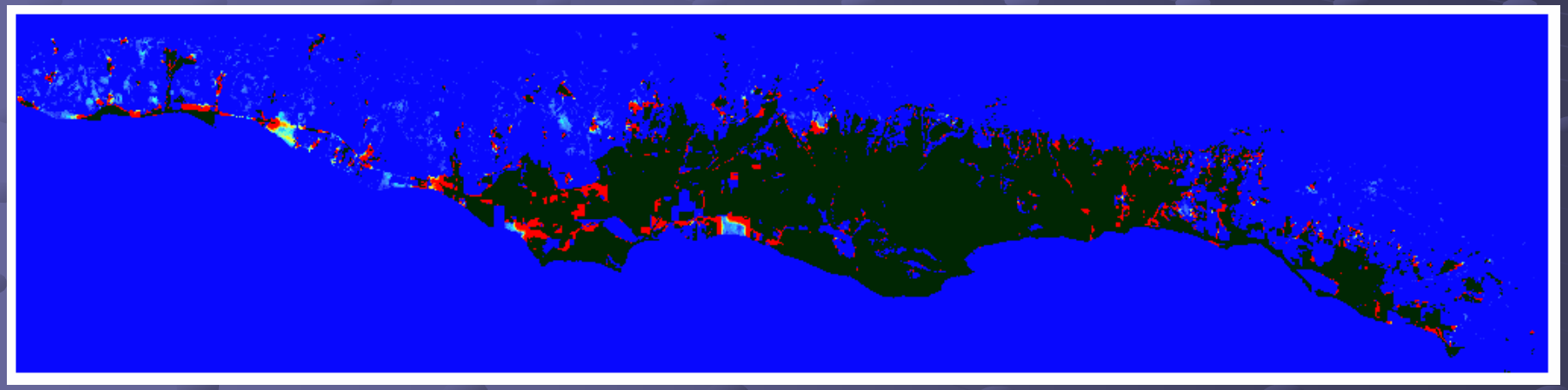
Landuse:

Natural Veg	(High)
Urban	(Medium)
Road	(Zero)

Modeling Santa Barbara

Santa Barbara Vesta Modeling

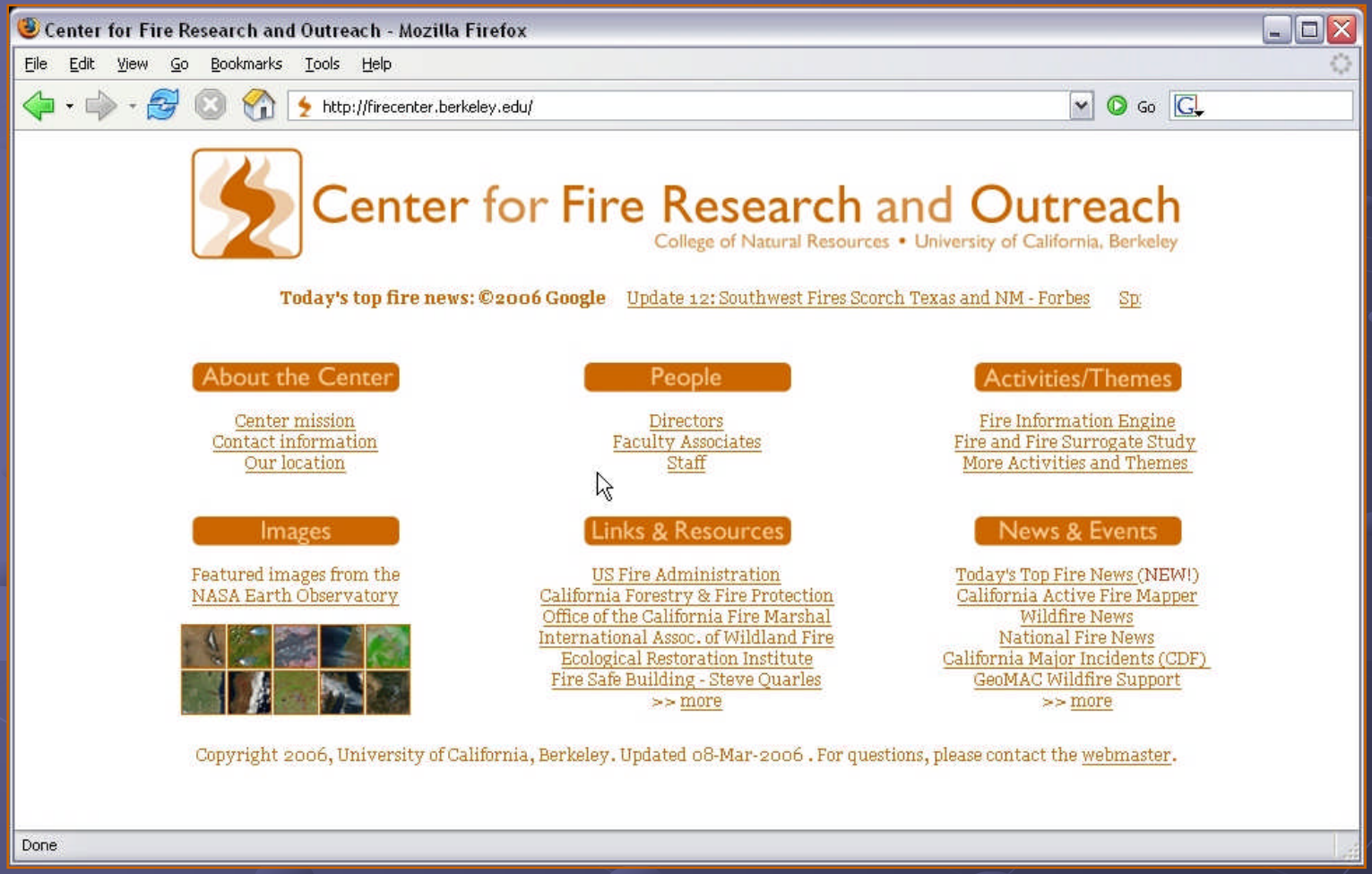
- Growth forecast to 2020



Vesta Conclusions

- Adaptation to high risk leads to:
  - Lower Wildfire Risk
  - Reduced Urbanization
- Global and local policy changes
  - Vesta as a policy tool
  - Vesta as an analytic tool (past & future)
- Defensible Space
- More data parameterization

Current Research & Collaboration

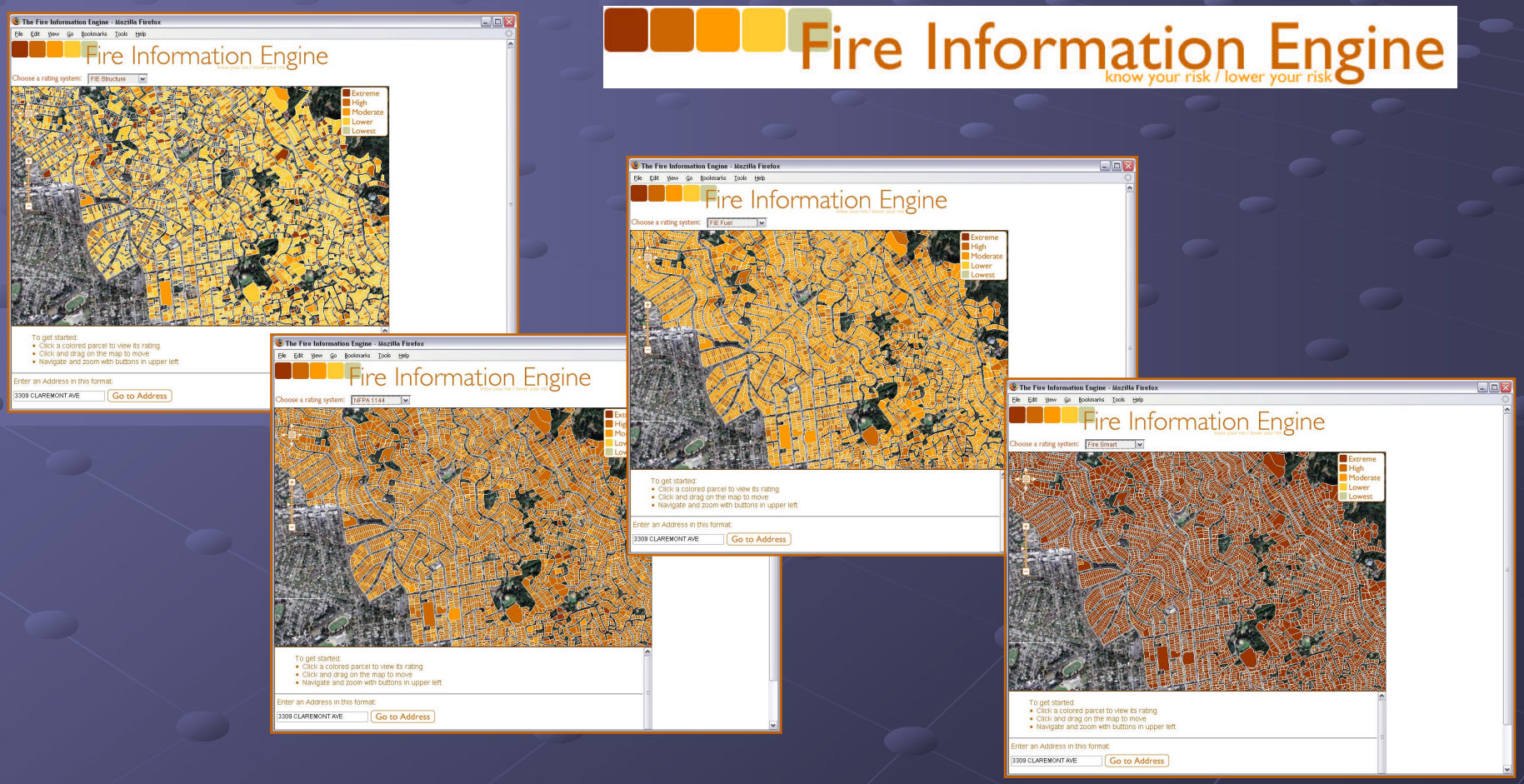


firecenter.berkeley.edu

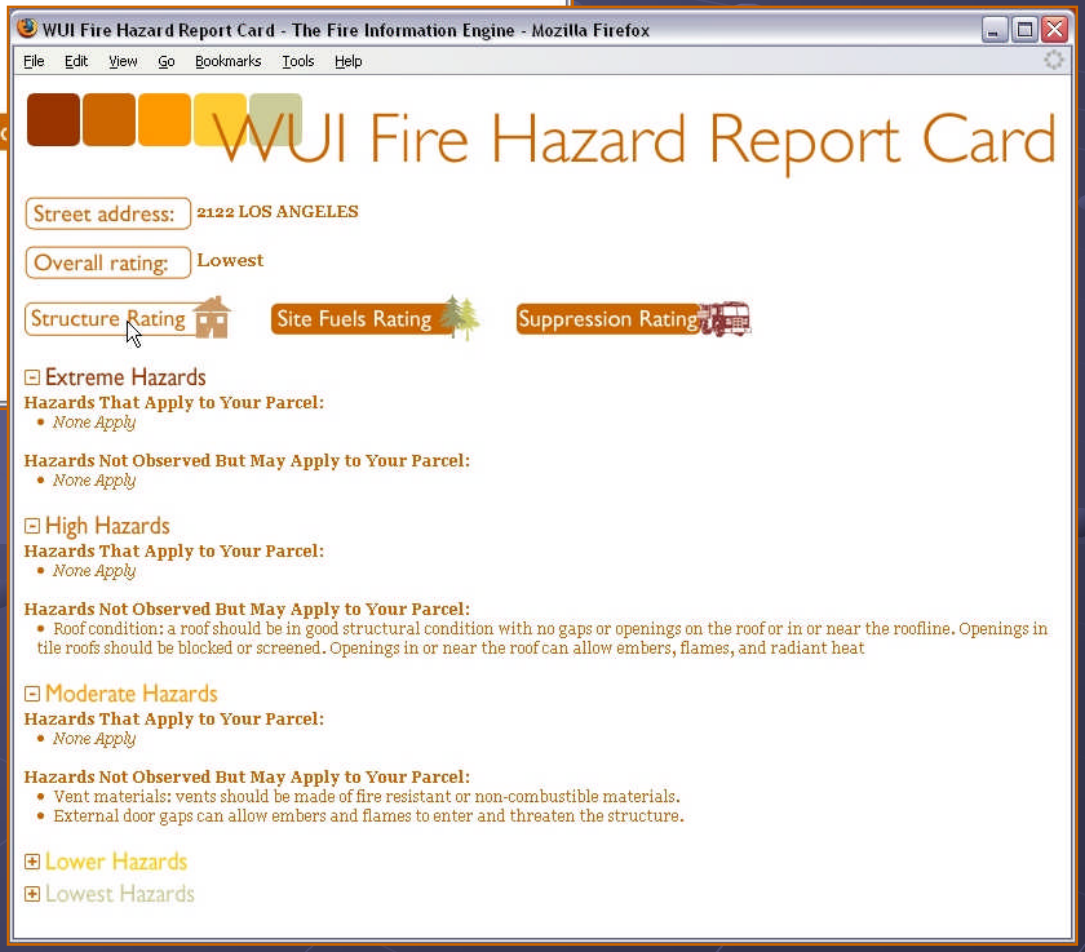
Established at the University of California, Berkeley with financial support from the University and the Department of Homeland Security

Current Research & Collaboration

- Wildfire Risk Mapping
  - Comparative Strategies for Local Citizens

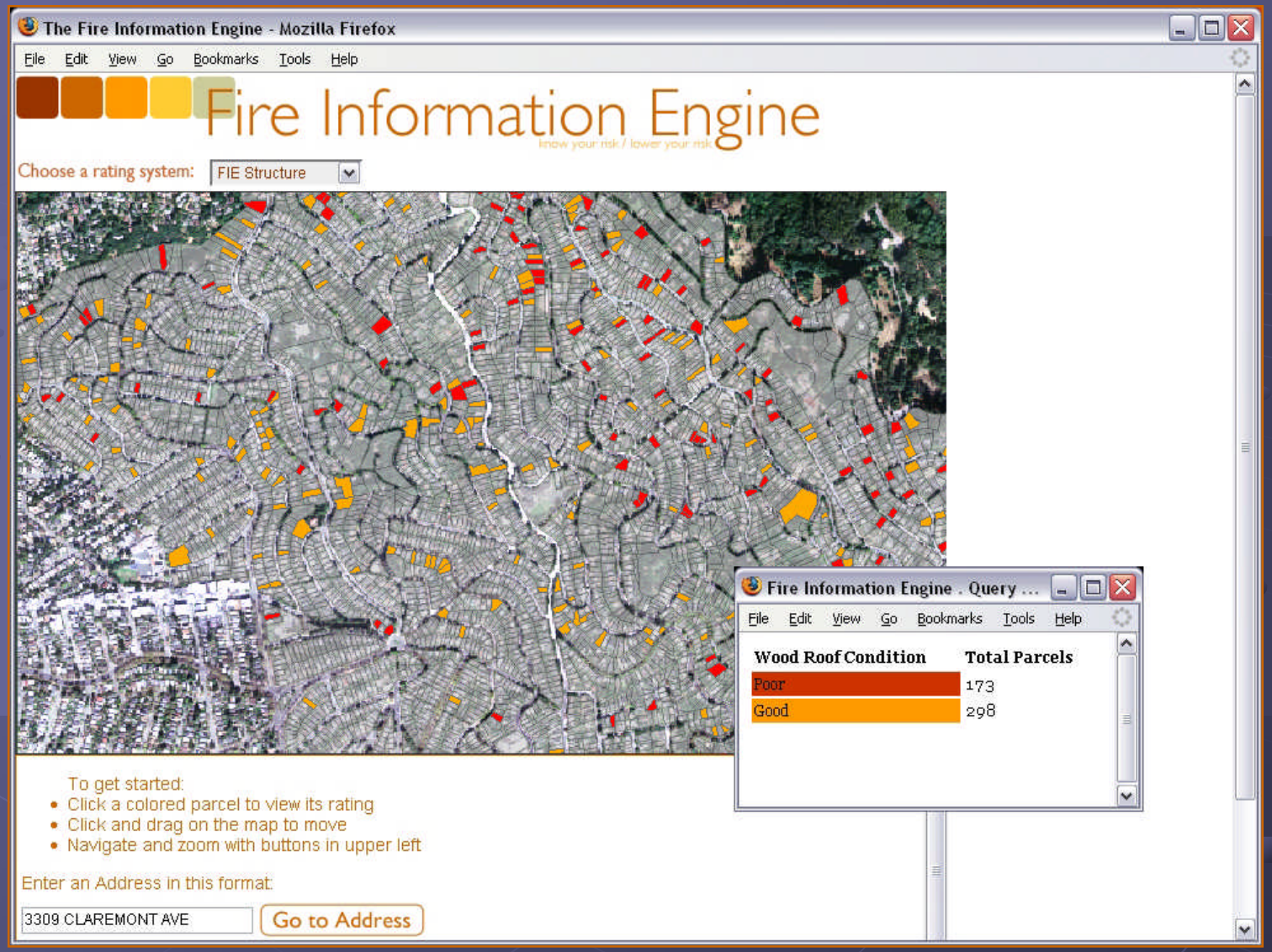


Zoom in and click to get parcel level "report card" that lists fire hazard rating – focus on interpretation of results.



Currently developing materials that will focus on for suggestions for improvement – including time, cost, etc.

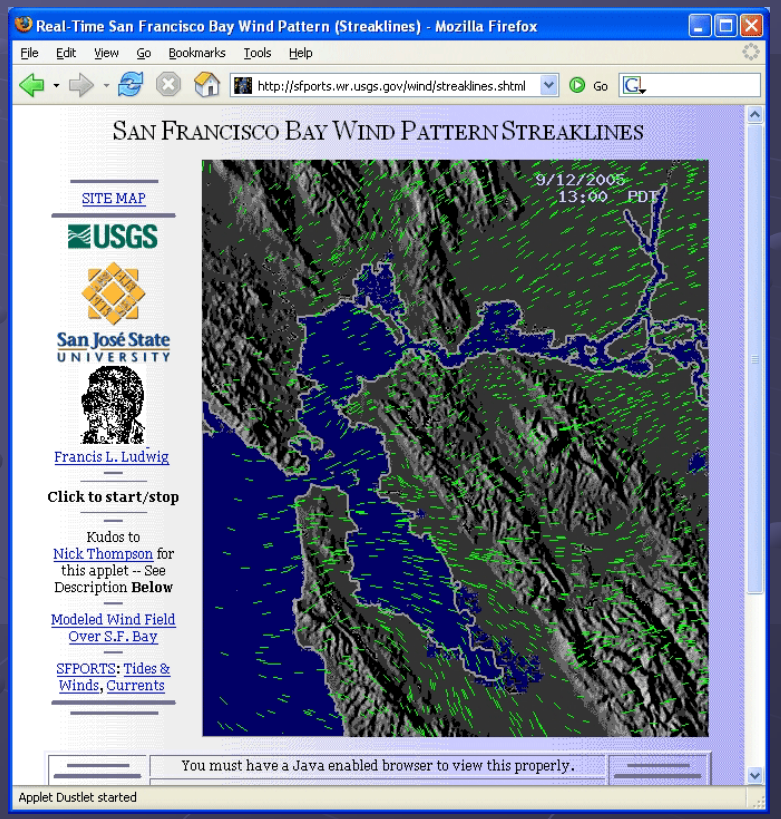
Tools for Decision-makers

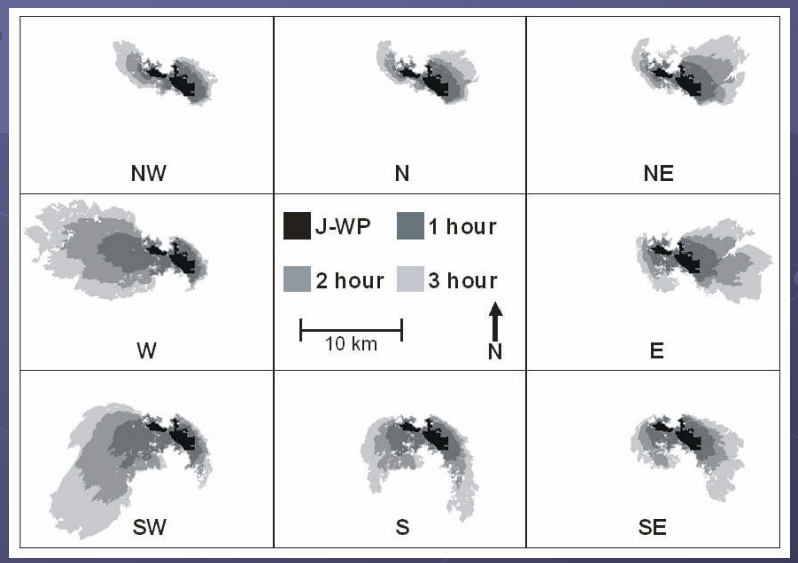


Example: Locate all wood roofs in poor condition to explore the implications of a roof rebate program.

Future Directions of Fire Modeling

- Integration with other GIS
- Hand-held tools
- Real-time modeling
- Evacuation Modeling





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